

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Application No.: 10/534,110 Confirmation No.: 5161
Applicant: Flytzani-Stephanopoulos et al. Filed: May 6, 2005
Technology Center: 1700
Art Unit: 1793 Examiner: Jennifer A. Smith
Docket No.: TFU-0001 Customer No.: 88993
TITLE: CATALYST HAVING METAL IN REDUCED QUANTITY AND
REDUCED CLUSTER SIZE

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REPLY TO EXAMINER'S ANSWER

PURSUANT TO 37 C.F.R. §41.41

This is an appeal from the final rejection of the above-identified application dated December 19, 2008. An appropriate Notice of Appeal and the required fee were filed on March 19, 2009. An Appeal Brief was timely filed on April 17, 2009 with a Petition for a one month extension of time. The Examiner provided an Examiner's Answer mailed from the United States Patent and Trademark Office on June 9, 2009. The filing of this communication on August 7, 2009 is believed to be timely. Applicants believe that no fees are due on account of the filing of this paper.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzani-Stephanopoulos et al.

In the event that any fees not otherwise paid herewith are due in connection with the submission of this Reply to Examiner's Answer, Applicants hereby authorize and specifically request that such fees be charged to Deposit Account No. 50-4969.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzani-Stephanopoulos et al.

REAL PARTY IN INTEREST

The real party in interest is Tufts University, a Massachusetts corporation. The assignment from the inventors to the real party in interest was recorded on May 6, 2005 at Reel 017321, starting at Frame 0364.

Reply to Examiner's Answer

U.S.S.N. 10/534,110

Inventor: Fltzani-Stephanopoulos et al.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzanji-Stephanopoulos et al.

STATUS OF THE CLAIMS

Claims 1-20 stand finally rejected.

Claims 21-44 were withdrawn from consideration due to a restriction requirement.

Claims 1-20 are on appeal.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
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STATUS OF THE AMENDMENTS

No amendments have been filed after the issuance of the Final Office Action.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzani-Stephanopoulos et al.

SUMMARY OF THE CLAIMED SUBJECT MATTER

The claimed subject matter was summarized in the Appeal Brief and will not be further summarized here. The previous summary is incorporated by reference.

The claims as recited in the Claims Appendix of the Appeal Brief are incorporated by reference.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzanaki-Stephanopoulos et al.

GROUNDΣ OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection were stated in the Appeal Brief and are not repeated verbatim here.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzanji-Stephanopoulos et al.

ARGUMENT

1. The Examiner appears to be misinterpreting the clear language of claim 1.

The Examiner's Answer states at page 3:

In regard to claims 1 and 2, Liu et al. teach a catalyst preparation method. A lanthanum-cerium nanocrystalline support is provided. Gold nanoparticles (crystalline structure) are deposited on the support [See page 318, Sections 2.1, 3.1]. **The total structure lacks a shared crystalline structure.** (emphasis added)

The Examiner appears to be misunderstanding the plain language of claim 1, which recites (emphasis added):

A method of preparing a catalyst material, comprising the steps of:
providing a substrate component having a surface;
producing on said surface of said substrate component a second component having metallic crystalline particles and a structure lacking crystallinity; and removing selectively from said surface of said substrate component at least some of said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity;
whereby said remaining structure lacking crystallinity associated with said substrate component exhibits catalytic activity.

As previously recited in the Appeal Brief, the application as filed recites explicitly in the Detailed Description of the Invention, at paragraph [0055], in relevant part:

In general terms, the disclosure describes **catalysts having active metallic constituents deposited on metal oxide substrates, and subsequently chemically treated to remove therefrom significant amounts of the metallic constituent, including substantially all of the crystalline deposited metal.**

Reply to Examiner's Answer

U.S.S.N. 10/534,110

Inventor: Fltzanaki-Stephanopoulos et al.

Deposited active metal remains on or in the substrate in a form or forms that are smaller in size than one nanometer. In one embodiment, the metallic constituent is a structure lacking crystallinity. It is thought that the structure lacking crystallinity contains so few atoms that a crystalline structure electronic metallic character is not observed. The catalysts have been discovered to operate with undiminished efficiency as compared to the deposited metallic constituent that includes nanocrystalline metallic particles on the same substrates. The removal of the majority of the metallic constituent, in some cases as much as 90% thereof, does not compromise the catalytic nature of the material, while providing substantial reductions in cost, especially when the metallic constituent comprises gold, platinum, or other precious metals. In some embodiments, the substrate is a zeolite, carbide, nitride, sulfate, or sulfide. (emphasis added)

The application at paragraph [0056] recites:

The invention relates to heterogeneous catalysts for oxidation reactions, and to methods for producing and using the same, in which the metal catalyst is formed in an atomically dispersed condition in a substrate, while maintaining the activity and stability normally associated on such a catalyst with much larger amounts of metal atoms exposed on nanometer (nm) sized metallic particles. (emphasis added)

As previously recited in the Appeal Brief, at paragraph [0057] the application recites in relevant part:

The methods involve the production of a highly defective surface on an oxide (e.g. common catalyst supports such as ceria, titania, alumina, magnesia, iron oxide, zinc oxide, and zirconia) **and the incorporation of atomically dispersed metals** (as ions, neutral atoms, or clusters of atoms too small to exhibit metallic character) **on or in such a surface, followed by removal of significant amounts of the metal that is deposited in nanocrystalline form.** The removed metal part is recovered in the process. ... (emphasis added)

In addition, the application as filed recites explicitly at paragraph [0145]:

[0145] Fig. 26 and Fig. 27 taken together strongly suggest that the presence of gold having a structure lacking crystallinity in association with a defect oxide is effective in providing catalytic activity.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltziani-Stephanopoulos et al.

The Examiner has repeatedly stated that the claim recites a total structure (e.g., the substrate taken with the metallic component) that **lacks a shared crystalline structure**.
[Examiner's Answer at page 3 quoted above; same response *verbatim* in Non-Final Office Action mailed April 28, 2008 at page 5].

In the Final Office Action mailed December 19, 2008, the statement is made that:

Applicant argues the references fail to teach or suggest "producing on said surface of said substrate component a second component having metallic crystalline particles and a structure lacking crystallinity". A lanthanum-cerium nanocrystalline substrate is provided. Metallic gold particles are deposited on the support [See Liu, Sections 2.1, 3.16]. The gold is in the form of nanoparticles [See Liu, Table 4] and lacks a shared crystallinity for this reason.

Nowhere in claim 1 is there a limitation that the substrate taken with the metallic component lacks a shared crystalline structure. In fact, there is no discussion at all of a comparison or relationship between the structure of the substrate and the structure of the metallic component.

2. All of the arguments made by the Examiner ignore the plain language of claim 1, as read in plain English, and further in light of the Detailed Description of the Invention.

The second clause of the claim clearly states that the second component has metallic particles and a structure lacking crystallinity. There is no suggestion that the lack of a single crystalline structure between the substrate and the metallic component is being claimed.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltziani-Stephanopoulos et al.

However, the Examiner has repeatedly asserted that such is the claim and that Liu so teaches. Specifically, the Examiner's Answer at page 7, lines 9-10 states "In this way the substrate is the lanthanum-cerium support and the second component is understood to be the gold nanoparticles." Then the Examiner goes on to suggest that the gold nanoparticles are inherently crystalline. If that is correct, what part of the second component is the structure lacking crystallinity? The Examiner ignores this part of the structure and argues the lack of crystallinity is the failure of the substrate and the gold nanoparticles to share the same crystalline structure. Such an interpretation is completely in contradiction to the plain language of the claim and the plain language of the Specification.

Claims are first read for being definite, and if necessary, the Specification is then consulted to resolve any possible indefinite interpretation. The Examiner's reliance on extraneous reference material to try to define the meaning of claim 1 is improper.

For the record, Applicants' attorney holds a Ph.D. in solid state inorganic chemistry with a minor in x-ray crystallography. One with such education and training recognizes that some of the arguments made by the Examiner are technically incorrect.

The Examiner asserts that "[g]old is inherently a crystalline metallic substance having a cubic face centered structure." [Examiner's Answer, page 7, lines 10-11] This assertion is true only if the gold is present in aggregations of sufficient numbers of gold atoms. It is not necessarily true for atomically dispersed gold atoms.

The Examiner asserts that Liu teaches that "small gold particles are evenly distributed on the support matrix. The particles have an average size of 8 nm. [Examiner's Answer at page 7, lines 11-13]

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzani-Stephanopoulos et al.

However, 8 nm (8 nanometers = 80 Angstrom) is roughly 30 atomic dimensions. A gold cube having 30 atoms on a side would imply a gold particle having approximately $30 \times 30 \times 30 = 9,000$ atoms. Such a large particle (as compared to mono-atomically dispersed gold) is crystalline, whereas "**the structure lacking crystallinity contains so few atoms that a crystalline structure electronic metallic character is not observed.**" See the Specification at paragraphs [0055] to [0057]. Therefore, by the Examiner's argument, Liu's 8nm gold particles are different from the atomically dispersed gold described in paragraph [0056] of the Specification, rather than being the same. The Examiner simply ignores the presence of mono-atomically dispersed gold provided on the substrate as the "structure lacking crystallinity" that is recited in the phrase "**a second component having metallic crystalline particles and a structure lacking crystallinity.**" The phrase "lacking crystallinity" does not mean the same thing as the phrase "lacking a common crystal structure with," or the phrase "which do not share a crystalline structure." Applicant's attorney recognizes the difference between the language recited in claim 1, and the phrase "**a second component having metallic crystalline particles which do not share a crystalline structure with . . .**"

As Applicants have repeated made clear, the claimed method is claiming a method of making a catalytic material that includes a substrate and a metallic component lacking crystallinity, which is brought about after removal of some (or all) of the crystalline metallic particles, and which method (or structural combination in the case of apparatus or manufacture claims) is not taught or suggested individually or in combination by any or all of the references cited by the Examiner.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzanaki-Stephanopoulos et al.

Rather than dealing with this failure of the references to teach or suggest the invention as claimed, the Examiner appears to deliberately (and repeatedly) misconstrue the claim to require an element not claimed (e.g., the lack of a single crystalline structure between the substrate and the metallic component) even after Applicants have pointed out that the claimed invention is not dealing with the crystalline relationship between the substrate and anything else, but rather that the invention involves a substrate that supports a metallic substance that lacks a crystalline structure (e.g., mono-atomically dispersed gold).

Applicants respectfully submit that the Examiner does not have the authority to interject a new claim element ("The total structure lacks a shared crystalline structure.") not present (and nowhere discussed in the Specification) as a basis for supporting a rejection over references that themselves do not teach or suggest the presence of a metallic component lacking crystallinity (such as mono-atomically dispersed gold), or the removal of crystalline metallic material to leave behind a metallic component lacking crystallinity.

2. The Examiner argues that the failure of Liu to teach the step of "removing selectively from said surface of said substrate component at least some of said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity" is remedied by Bartlett.

Bartlett teaches methods of gold mining. Bartlett describes the process of heap leaching that can last for days or weeks, so as to recover gold. Bartlett does not suggest any benefit to be found in leaving any gold behind in the heap. Bartlett does not suggest any catalytic activity for gold left behind in the heap.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzani-Stephanopoulos et al.

Applicants respectfully submit that a reference that is intended to remove every possible atom of a precious metal for the purposes of recovering the metal, and that teaches that the remaining material is simply waste hardly qualifies as a reference that teaches the utility of leaving gold on a substrate in order to provide catalytic activity. If Bartlett is taken at face value, it teaches stripping every atom of gold from the substrate of the present invention if at all possible, leaving nothing left to provide the observed catalytic activity.

The Examiner takes both side of the same argument.

At page 8, last line, to page 9, line 2 of the Examiner's Answer, the Examiner states:
"Cyanide leaching processes are not capable of removing all of the gold and so the removal of a selective amount of gold is to be expected when the composition developed by Liu et al. is subjected to such a removal process."

However, the Examiner then goes on to contradict this very statement, citing the Bartlett reference as proof.

At page 9, last two lines, to page 10, line 1, the Examiner states that "Bartlett et al. teach removal of gold via cyanide leach solutions [See Pages 17-18, 20-21] at up to 100% of gold via NaCN leaching [See Page 22, Figure 2.3] and various amounts that are included in the interpretation of 'selective' range."

Applicant respectfully submits that the Examiner can't have it both ways – either NaCN does or does not dissolve 100% of the gold. If Bartlett teaches removing 100% of the gold by leaching, as the Examiner appears to state, applying Bartlett would destroy the catalyst of Liu, rather than yield the catalyst of the invention.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Flytzani-Stephanopoulos et al.

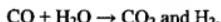
3. The Examiner appears to have made a clear error in discussing claim 17.

The Examiner states, at page 6 of the Examiner's Answer, first two lines:

"In regard to claim 17, the Liu reference discloses use of the catalyst for total oxidation of carbon monoxide and methane (water gas shift reaction)."

As a preliminary matter, Applicants note for the record that the Examiner in the Office Action dated April 28, 2008, at pages 2 and 3 of the detailed action, referred to the Liu reference in detail and required correction of a typographical error in the Specification citing the Liu reference. The Examiner explicitly stated the name of the second author (M. Flytzani-Stephanopoulos) who is the first named inventor in the present application. One would expect that as an author of the cited reference, inventor Flytzani-Stephanopoulos would be familiar with its content, and could discuss what the reference teaches with specificity.

Applicants have previously explained (*see* the Response to Office Action filed on September 19, 2008, at page 16-17) that the water gas shift reaction does not involve any net oxidation of the reagents (carbon monoxide and water), but rather the conversion given by

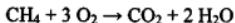
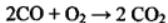


See also the Baumann reference, US Patent No. 6,723,298, at column 1, lines 15-28, which reference was cited by the Examiner, for a similar discussion of the water gas shift reaction.

The reader will note that there is a fuel gas (carbon monoxide, CO, capable of being oxidized) on the left (reagent) side of the reaction, and a different fuel gas (hydrogen, H₂, also capable of being oxidized) on the right (reaction product) side of the reaction.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Fltzani-Stephanopoulos et al.

Applicants explained that Liu teaches the **total oxidation** of gases such as carbon monoxide and methane, which reaction involves combining free oxygen with a reagent, and results in a totally oxidized product, for example as shown in the reactions:



in which the products CO₂ and H₂O are fully oxidized forms of carbon and hydrogen, respectively.

In the September 19, 2008 Response at page 17, lines 6-9, Applicants explicitly stated "It should be apparent that such total oxidation is incompatible with the water gas shift reaction, in which hydrogen is a product, because in the presence of air, hydrogen will be oxidized to water, and will not be available as a product."

Applicants respectfully submit that if the Examiner can state for the record that the "use of the catalyst for total oxidation of carbon monoxide and methane" is the water gas shift reaction, or is equivalent to the water gas shift reaction, then the Examiner has made an unacceptable error of fundamental significance. In such a circumstance, the familiarity of the Examiner with the subject matter being examined is respectfully questioned.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Flytzani-Stephanopoulos et al.

4. Applicants have also argued that there is no motivation to make the combination of references that the Examiner has proposed, other than based on improper hindsight.

MPEP §2143.01 VI

VI. THE PROPOSED MODIFICATION CANNOT CHANGE THE PRINCIPLE OF OPERATION OF A REFERENCE

If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959)

Applicants respectfully submit that the rejection of claims 1-18 and 20 on the basis of a combination of the Liu and Bartlett references, and the rejection of claim 19 on the basis of a combination of Liu, Bartlett, and Baumann is a facially insufficient rejection in view of MPEP §2143.01 VI, and should be overturned. Applicants' reasoning, presented previously as well, is that the subject matter of Liu (total oxidation of carbon monoxide and methane) and the subject matter of Baumann (water gas shift reaction) are incompatible with each other (as again pointed out in item 3 hereinabove). An attempt to combine a reference teaching total oxidation with a reference teaching the water gas shift reaction requires that the principle of operation of at least one of the references be changed. Applicants further argue that Bartlett, discussing gold mining by solution mining methods has nothing to do with catalysis at all. Applicants respectfully submit that the Examiner has engaged in impermissible hindsight, has misrepresented or misunderstands the teachings of the various references, and is attempting to combine references in a manner that contravenes the guidance of MPEP §2143.01 VI.

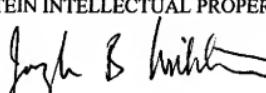
Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Flytzani-Stephanopoulos et al.

CONCLUSION

The inventions recited in claims 1-20 are neither taught nor suggested by the prior art cited by the Examiner. The Examiner appears to have made at least one error of such fundamental significance as to raise doubts about the understanding of the Examiner as to the subject matter at hand, even after Applicants explained the subject matter being cited, which was authored by Applicants. For the reasons presented hereinabove, the Examiner's Grounds for Rejection of these claims pursuant to 35 U.S.C. §103(a) are wholly inappropriate by virtue of being based on failure to correctly construe the claims, factual error, application of references in a manner that violates the guidance of the MPEP, impermissible hindsight, a failure to identify a motivation to combine cited references, and/or a failure to demonstrate that the cited references teach or suggest all of the claim limitations. Thus, a favorable decision reversing the Examiner's rejections of claims 1-20 is respectfully requested.

Respectfully submitted,
MILSTEIN INTELLECTUAL PROPERTY LAW LLC

By:


Joseph B. Milstein, Ph.D., Reg. No. 42,897
80 Beals Street
Brookline, MA 02446-6011
Tel: (617) 699-9909
Email: jmilstein@jbmiplaw.com

Date: August 7, 2009

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Flityzani-Stephanopoulos et al.

EVIDENCE APPENDIX

No additional evidence beyond that already cited.

Reply to Examiner's Answer
U.S.S.N. 10/534,110
Inventor: Flytzani-Stephanopoulos et al.

RELATED PROCEEDINGS APPENDIX

None.